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About anomalous ultrasound attenuation in aerogels filled in by liquid 4He below Tλ

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Abstract

In the present work we propose the explanation of the recently observed at temperatures about 1.7 K anomalous ultrasound attenuation in high-porous aerogels filled in by liquid 4He by means of 2D-3D roton transformations. The existence of so-called 2D rotons in the system "aerogel-liquid 4He" has been found early in the experiments on inelastic neutron scattering T < 1.5 K where the spectrum of roton excitations is well-defined. The difference in energies of 3D-rotons and 2D-rotons at low temperatures exceeds the energy of acoustic phonons and the process of transformation of 2D-roton to 3D-roton is forbidden by energy conservation law. But with increasing temperature the 2D-roton and 3D-roton states begin to be broadened (the lifetime of excitations is decreasing) and possibility of the mutual transformation of rotons with the participation of a phonon appears. The further increasing of temperature leads to the essential decreasing of superfluid density and the efficiency of the proposed mechanism decreases too. Numerical simulations show the qualitative agreement of the proposed mechanism with the observed data. © 2009 IOP Publishing Ltd.

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